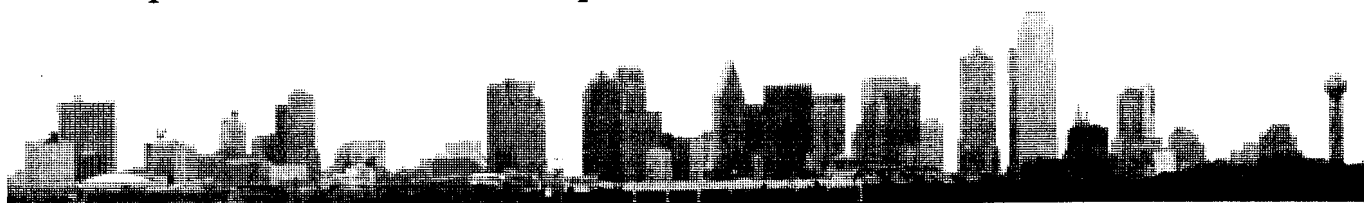


MCCC NEWS

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MicroProcessors

two decades of microprocessor history — by Stephen J. Bigelow
from The Abilene Amiga User Group Newsletter

Since the days of the first vacuum-tube computer, designers have sought better, faster, and cheaper computer performance. Improvements in these areas directly mirror the evolution of device technology from vacuum tubes to transistors, integrated circuits, Large Scale integration (LSI), and Very Large Scale Integration (VLSI). Important milestones along the way include the introduction of integrated circuits in 1964, and the introduction of the microprocessor — often called the MPU (microprocessing unit) or, more commonly, CPU (central processing unit) — in 1971.

This article provides an overview of how both microprocessors and the computer industry have evolved. Whether you are a computer user, hobbyist, technician, or designer, this article will help you understand what microprocessors are, how they work, and how they developed. The article also includes a capsule history of microprocessor development, and a glossary of microprocessor-related terms.

What is a microprocessor?

The internal workings of today's microprocessors are certainly more sophisticated than those of such pioneers as the 6502 (MOS Technology), the MC6800 (Motorola) or the 8080 (Intel). Even so, today's complexity only builds on underlying architectures that have remained almost unchanged for 20 years.

At heart, the microprocessor is an "engine" that performs arithmetic and logic functions in a generalized way. Ordinary logic ICs are designed to produce specific outputs based on specific inputs and internal logic. By contrast, the microprocessor's outputs are determined by stored logic — software — that can vary.

For example, Fig. 1 shows a block diagram of the 8-bit 8080A CPU. Although it might appear imposing at first glance, each block falls into one of three categories: registers, instruction/control elements, and the arithmetic logic units or ALU.

Registers

Registers are individual RAM locations that are contained within the microprocessor itself. Nearly every microprocessor has a register called the accumulator, which stores values and the results of arithmetic and logical operations.

Another important register shared by nearly all microprocessors is called the program counter, which tracks the address in the computer's main RAM memory where the next program instruction will come from. While the microprocessor is executing a current instruction, it also updates the program counter to point to the address of the next instruction. The actual program instruction that is to be executed is passed to the instruction decoder via the instruction register.

The CPU can also jump to another location in RAM to execute an instruction, in several ways. One is to Jump or Branch directly to that location and continue program execution there. Another is to execute a subroutine, usually via a Call, Jump to Subroutine, or Branch to Subroutine instruction. After the subroutine completes its duties, the CPU resumes program execution at the instruction that immediately follows subroutine-Call, -Jump, or -Branch instruction.

When the CPU performs a Call, it pushes the contents of the program counter onto a special section of main computer memory called the stack. Conversely, when returning from a subroutine, the address is then popped off the stack and loaded back into the program counter. Another CPU register called the stack pointer keeps track of the next free location on the stack. As the CPU calls subroutines (pushes) and returns from them (pops), the stack pointer slides up and down the stack. The stack can also store the contents of various CPU registers.

Other registers are used for temporary data storage and to index memory. For example, in the 8080, the H,L,D,E,B,C,W,Z as well as the Accumulator, are all 8-bit registers that serve as general-purpose (or scratchpad)

registers. Newer microprocessors contain more and larger registers, but the concept is the same.

Instruction/Control

To execute a program instruction, the CPU must usually perform a series of steps such as reading data from a memory or input/output (I/O) location, writing data to a memory or I/O location, manipulating the contents of one or more CPU registers, and handling the results of ALU operations. The actual series of steps depends on the particular instruction. Thus, each instruction must be translated by an instruction decoder from the single machine-language instruction into a series of simple functions that the CPU can execute.

Keeping all of the components of a CPU running smoothly requires precise timing and synchronization, which is usually managed by a crystal-based clock/oscillator. Early CPUs such as the 8080A required an external oscillator. Today's CPUs contain internal oscillators that require only an external crystal and perhaps a small capacitor or two.

Each clock pulse allows the CPU to perform one operation. However, one instruction can require several operations. As a result, it may take 20 to 30 clock pulses for a CPU to perform a complete instruction, such as adding two numbers.

There are two basic ways to enhance CPU speed: 1) increase clock speed, and 2) decrease the number of operations that are required to execute each instruction.

For example, suppose that 25 clock pulses are needed to perform a simple addition. If the CPU clock ran at 10 MHz, each clock pulse would take 0.1 microsecond (us), so the addition would be completed in $(25 \times 0.1 \text{ us}) = 2.5 \text{ us}$. If the CPU ran at 60 MHz, each clock pulse would be only 16.7 nanoseconds (0.0167 us), so the same addition would be complete in $(25 \times 0.0167 \text{ us}) = 0.4175 \text{ us}$. That value represents a six times improvement in raw speed. The other way to improve performance is to reduce the number of operations required per instruction. Today's microprocessors use both techniques.

Several control signals influence a microprocessor's operation. One important, for example, is reading and writing memory and I/O ports. How does the system distinguish between reads and writes? Some microprocessor families have a single read/write line; the Intel family has separate read and write lines. Whenever the CPU wants to write some data to memory or to an input/output (I/O) port, it asserts (brings low) its write line. Likewise, when it wants to read data, it asserts its read line.

Another important function involves interrupts. Whenever a situation requiring the CPU's attention occurs, the CPU's current task can be interrupted, and its focus shifted to the interrupting task. Devices such as keyboards, disk drives, and memory-refresh circuits demand the CPU's attention with interrupt requests (IRqs). Early CPUs such as the 6800, the 6502, and the 8080 had a single interrupt input. Many current devices offer as many as 16.

Another potential problem that a microprocessor must contend with is the varying speeds of devices in a computer system. The CPU is usually the fastest device in a system; memory and I/O ports are typically slower, and mechanical devices such as disk drives are slower yet. Because of these speed differences, an external device may not be ready when the CPU tries to read it. To ensure coordination, microprocessors have wait and ready signal lines, which allow the CPU to idle for a clock pulse. That idle period is called a wait state. Although wait states are still common in computer systems today, good system design minimizes their use.

The last control function to be discussed here is microprocessor reset. When asserted, the

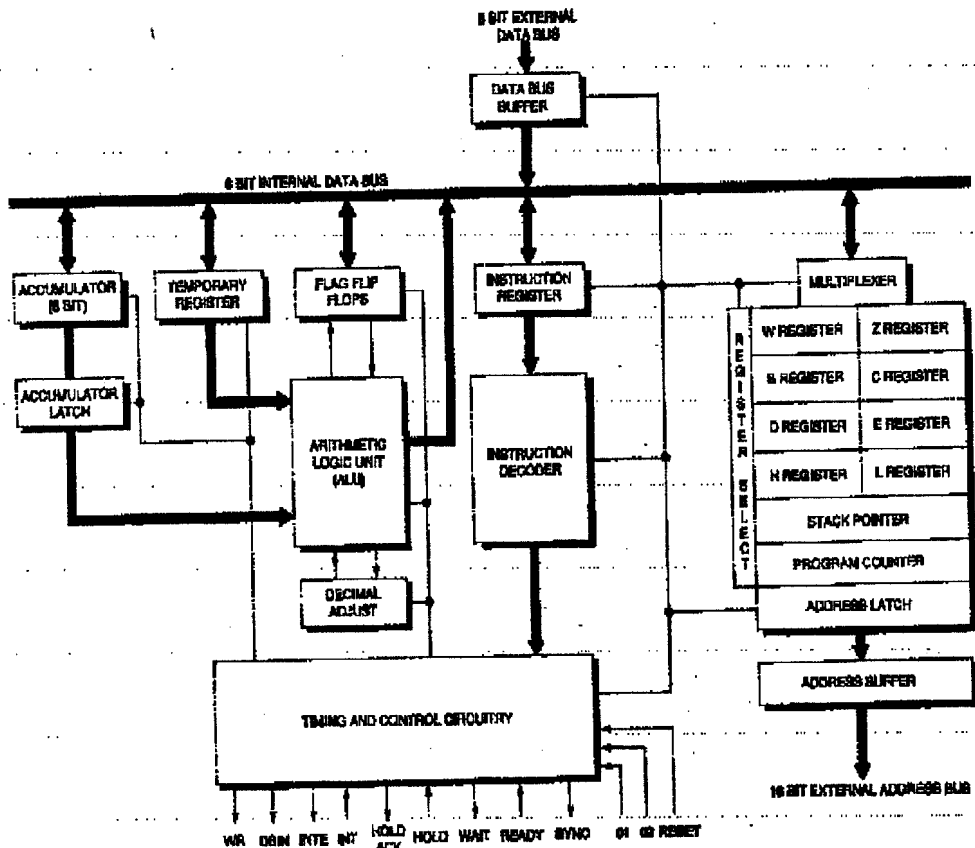


FIG. 1—ARCHITECTURE FOR A GENERATION: Intel's 8080 microprocessor, as used in the original IBM PC.

reset line of a microprocessor sets all the registers to known states and begins program execution at a specific location in memory.

ALU

The real power in a CPU is not in its registers or control section, but in its Arithmetic/Logic Unit (ALU). The ALU is the "brain" within the CPU; it is what carries out most logical operations, comparisons, and arithmetic functions. Some CPUs delegate high-order math functions to a separate math coprocessor, but most ALUs add, subtract, increment, decrement, compare, and perform logical operations (AND, OR, NOT, XOR). After each ALU operation, a set of result flags indicates the status of the result (carry, borrow, or zero).

The Intel Family

Intel CPUs have been at the forefront of desktop personal computing since IBM selected the 8088 for use in its first IBM PC. Since it was introduced, the so-called x86 architecture has undergone five major evolutionary stages. The first generation includes the 8088, the 8086, and the 80186. The next three generations include the 80286, the 80386, and the 80486. The fifth and most recent includes the Pentium. Intel is already working on both the sixth and seventh generations, as yet unnamed.

The head of the family is the 8086. In the era ruled by 8-bit microprocessors, the 8086 quickly became the first widely-used 16-bit microprocessor. (When speaking of the number of bits a microprocessor has, data-bus width is usually the value referred to.) In addition to doubling the data bus width from 8 to 16, the 8086 also increased the number of address lines from 16 to 20, thereby providing what seemed at the time an abundant one megabyte of addressable memory.

The 8088 is essentially the same chip as the 8086, except that its 16-bit data bus is multiplexed down to 8 bits. That trades off system costs at the expense of performance. Data-bus bandwidth decreases by more than a factor of two from the 8086 to the 8088. Multiplexing the data bus down to half its internal width is a "trick" Intel played over and over in the evolution of the 8086 line.

The 80186 is an 8086 with several common support functions built right in: clock generator, system controller, interrupt controller, DMA (Direct Memory Access) controller, and timer/counter. No Intel CPU before or since has offered as much integration in a single package. The 80186 was also the first to abandon 5-MHz clock speeds in favor of 8-, 10-, and 12.5-MHz rates. The 186 was not used as a mainstream CPU for desktop computers; rather, it was limited to "embedded" applications.

The 80286 offered the first real architectural advance over the 8086. The 286 pushed memory to 24 address lines, resulting in a 16-megabyte address space. In order to access all that memory, the 286 also introduced a new mode of operation, called protected mode.

The 80286 booted in an 8088/86-compatible mode

called real mode, but through a special instruction, it could switch into the more advanced protected mode to gain access to the additional memory, as well as to advanced programming features. However the only way to get back into real mode from protected mode is to force a complete reset of the microprocessor — a time-consuming process that eliminated the 80286 as a viable engine for running multitasking(?) operating systems such as Windows and OS/2.

The next major advance came in 1985; the 80386. It was Intel's first 32-bit microprocessor, and provided 32 bits on both the data and address buses. Like the 286, the 386 boots in real mode. It also offers a protected mode, multiple simultaneous "virtual" real-mode sessions, and efficient mode switching. The 386 was the first Intel CPU to enhance processing speed through the use of instruction "Pipelining" (also known as scalar architecture), which allows the CPU to start working on a new instruction before completing the current one.

In 1988, Intel took a step "backward" with the 80386SX. It was built around the core 32-bit CPU of the 386, but provided only a 16-bit external data bus, and a 24-bit address bus. Although the performance of the 386SX was significantly lower than the 386, so was its price, so system costs could be reduced. Another version of the 386 came in 1990: the 80386SL. With its 24 address lines and 16-bit external data bus, the 386SL closely resembled the 386SX. But it also incorporated system functions for running a standard PC, and power-management circuitry that optimized the device for use in portable computers.

All members of the 386 family can operate with stand-alone math coprocessors (80387DX, 80387SX, and 80387SL).

The 486 Family

Like the 80386, the 80486 incorporates pipelining to improve instruction execution performance. The 486 also adds a new wrinkle: on-chip "cache" memory. Cache reduces memory-access time by storing copies of recently used instructions and data in fast static RAM, rather than relatively slow DRAM. Another improvement was the inclusion of a floating-point unit in the CPU itself.

Of course, Intel found ways to "SX" the 486 line to provide a less expensive option for system designers. Unlike previous SXs, the data-bus width was not halved on the 486SX. However, the 486SX does not include the on-chip floating-point unit or math coprocessor. One important innovation in the 486 line was the introduction of 3-volt devices for laptop computers and other low-power applications.

Another interesting feature of the 486 is its upgradeability. Computer systems based on prior generations were pretty much locked in to the performance level attainable by whatever the built-in CPU offered. But the 486 was designed from the beginning for upgradeability via what Intel calls "OverDrive" technology. OverDrive technology generally replaces your current CPU with one that runs twice as fast — internally. But you don't get twice the overall performance. Nonetheless, an OverDrive CPU is cheaper

than buying a whole new PC. It is vital to note that not all 486 systems are upgradeable via OverDrive technology; check with your computer's manufacturer to be sure.

The 486 has spawned numerous variations, including a full 50-MHz model (the 80486DX/50), and the aforementioned 486SX, which is upgradeable if the computer's motherboard was designed to accept an OverDrive CPU.

The first wave of OverDrive CPUs arrived in 1992 with the introduction of the 80486DX2/50 and the 80486DX2/66. The DX2/50 runs on a 25-MHz bus, but at 50-MHz internally; the DX2/66 runs at 66 MHz on a 33-MHz bus. The slower bus speeds allowed the OverDrive CPUs to work directly with existing PC motherboard designs. Both OverDrive CPUs offer internal math coprocessors, and are themselves upgradeable to even faster OverDrive versions. The DX2/50 is available in 3- and 5-volt versions, while the DX2/66 is available only in the 5-volt version.

In 1992, Intel produced a highly-integrated, low-power version of the 80486 called the 80486SL. Its 32-bit data bus, 32-bit address bus, 8 kilobytes of on-board cache, and integrated math coprocessor make it similar to other 486 CPUs. However, the SL includes power-management circuitry that optimizes the device for use in mobile computers. The 486SL is available in 25- and 33-MHz versions, and in both 3- and 5-volt designs.

In 1993 Intel rounded out the 486 family by introducing the 486DX2/40, the 80486SX/SL, and the 80486DX/SL. The DX2/40 is another OverDrive CPU, this one intended to run in 20-MHz PCs. The SX/SL and DX/SL devices are similar to the original versions, but with SL-type power-management capabilities. These devices in essence made the special 486SL mentioned previously obsolete, angering several manufacturers in the process.

The latest addition to the 486 line is the DX4 series, which are clock-tripled devices that run on 25- and 33-MHz buses. With the X4 nomenclature Intel appears to imply that the DX4's larger cache (16 kilobytes vs. 8 kilobytes in prior models) achieves greater than a three times performance improvement. All versions of the 486 run the same software, and are backward compatible with all x86 CPUs going all the way back to the 8086/8088.

The Pentium

By 1992, the 486 had become well-entrenched in everyday desktop computing, but Intel was already laying the groundwork for the next generation. Nearly everyone expected Intel to continue its traditional numbering scheme and dub the next CPU the 80586. However, Intel wanted more control over who used similar names for competing processors, so it changed to a name that is more easily trademarked: Pentium. It was introduced in 1993.

The Pentium retains the 32-bit address bus of the 486, but doubles the data bus to 64 bits. All versions of the Pentium include an on-board math coprocessor, and are

intended to be compatible with future OverDrive designs.

The Pentium has two 8-kilobyte caches — one for instructions and another for data. A dual-pipeline technique (known as superscalar architecture) allows the Pentium to process more than one instruction per clock cycle. Other substantial improvements include on-board power management (similar to the 486SL line). Currently the fastest released model runs at 100 MHz, and Intel has publicly demonstrated 150-MHz versions.

The Motorola Family

Intel CPUs (and the computers built on them) capture the majority of customers and market share in the PC industry. Nonetheless, Motorola has also enjoyed an excellent reputation in the microprocessor arena. Motorola CPUs have long been — and continue to be — the microprocessor of choice for Apple's line of personal computers. (Amiga computers too!) Many embedded and high-performance computer designs have also carried Motorola CPUs.

Motorola's initial microprocessor introduction was the 6800 in 1975. It was strictly an 8-bit processor capable of addressing 64 kilobytes of memory. Probably the most striking difference between the Motorola and Intel architectures is that early members of the 6800 family tended to minimize register usage in favor of general-purpose RAM.

Motorola introduced numerous variations of the 6800. The 6802 incorporated 128 bytes of RAM on the CPU itself. The 6803/6808 ran faster (3.58-MHz), incorporated 128 bytes of RAM, and included both a UART (universal asynchronous receiver/transmitter) for serial communications, and a counter/timer. The last variation of the 8-bit Motorola family was the 6809. It was similar to the 6802, but offered an enhanced instruction set, including what was probably the first multiply instruction on an 8-bit CPU.

Some of the earliest personal computer kits were based on the 6800 family, and Tandy built a version of the Color Computer that was rather advanced (for its day) around a 6809. However, by 1978, the age of the 16-bit CPU had begun, and the second generation of personal computers that included the Apple Macintosh and the IBM PC would be 16-bit machines.

The 68000 Family

In 1978 Motorola introduced its first 16-bit CPU: the 68000. Unlike Intel's 8086/8088, which could address only one megabyte of physical RAM, the 68000 had 24 address lines that could access 16 megabytes of RAM directly — it was an almost inconceivable amount of memory at the time. In addition, the 68000 ran faster than mainstream Intel processors of the day: 16 MHz. Also, Motorola abandoned the idea of RAM-based registers and incorporated 16 general-purpose registers in the 68000. It would be four years until Intel could approach the technology of the 68000.

Early Times In The PC Biz

Motorola entered the 32-bit CPU arena with the 68020. Like the 68000, the 68020 has 16 general-purpose registers, and can address four gigabytes of RAM directly. A first for the 68020 was the inclusion of an internal 256-byte instruction cache — negligible by today's standards, but a TRUE architectural advance at the time.

The 68030 is Motorola's second-generation 32-bit CPU. It is very similar to the '020, but is available in faster speeds, and with one 256-byte cache each for data and instructions.

The 68040 is the third generation. It increases the data and instruction caches to 4 kilobytes each, and, for the first time, includes an on-board math coprocessor and memory management unit.

One of the latest members of the 680x0 family is the 68060. The 68060 is a superscalar design that has multiple instruction pipelines, and on-board memory and power management.

PowerPC

After more than a decade of development, the 680x0 architecture simply ran out of steam, so Motorola teamed up with IBM and Apple to produce a new microprocessor with improved performance. The MPC601, or PowerPC, is a 64-bit superscalar CPU that can effectively execute up to three instructions per clock cycle. The PowerPC is the first implementation of reduced instruction set computing (RISC) for personal computers. (The 680x0 and 80x86 families use complex instruction set computing (CISC) technology.) With RISC, most instructions execute in only one clock cycle. Instructions can even be completed out of order, but the CPU will make them appear sequential. The MPC601 has a 32-bit address bus, 32 kilobytes of cache memory, and an internal math coprocessor. Apple appears to have bet its future hardware designs on the PowerPC architecture.

The Clones

The huge microprocessor market has attracted other manufacturers who want to cash in. In the mid-1980's, NEC "cloned" the 8088 and 8086. More recently, American Micro Devices cloned Intel's 386 and 486 CPUs. AMD strategy was not to cut prices, but to improve performance. For example, when 33-MHz 386's dominated the market, AMD introduced its model running at 40-MHz. The company has continued that strategy.

More recently, several manufacturers, including AMD, Cyrix, and NexGen have jumped in to the fray, attempting to produce Pentium-class CPUs. None of these has been released yet, but several introductions are planned for this year. IBM has signed deals to manufacture CPUs for both Cyrix and NexGen, so it looks like choices are going to multiply rapidly. ✓

The CPU powering the PC on your desk probably contains more than a million transistors. However, its lineage traces all the way back to Intel's 4004, which was developed in 1971. The 4004 was a four-bit processor. It contained 2,300 transistors, and ran at 106 kHz. The 4004 sold well and found service in early desktop calculators.

Following the 4004, Intel developed the 8008 (in 1972) and the 8080 (in 1974). It was the 8080 that really helped launch the personal-computer revolution. The 8080 could address only 64 kilobytes of memory, but it was the first well-accepted 8-bit microprocessor. Later (in 1976) Intel introduced the 8085, which was basically an 8080 compatible, but included enhancements such as faster clock rates and a richer instruction set. Motorola entered the CPU market in 1975 with its 8-bit 6800, and the 6502 was developed around the same time by MOS Technology.

By the late 1970's, the first wave of personal computers had hit the market. Tandy introduced the 8080-based TRS-80 Model 1 in 1977. The 6502-based Apple II also appeared in 1977. In 1979 came the 6502-based Commodore PET. Dozens of companies produced 8080- and Z80-based machines that ran the first "business" operating system, CP/M. CP/M originally stood for Control Program/Monitor, but eventually took on the meaning Control Program for Microcomputers.

But even as the 8-bit market was developing, the era of 16-bit computing loomed ahead. By 1978, Intel developed its first 16-bit CPU: the 8086. Then, in 1979, Intel found a way to multiplex the 16-bit data bus down to 8 bits, thereby allowing systems to be built less expensively. The 8088 and the 8086 offered 20 address lines, which gave them a memory capacity of 1 megabyte — 16 times more than the 64 kilobytes offered by the 8080, 6800, and 6502.

Motorola parried Intel by introducing the 68000, a TRUE 16-bit CPU. Apple shortly abandoned the aging 6502 and used the 68000 in the Macintosh. Zilog attempted to stay in the 16-bit competition with the Z8000, but was unable to attract interest from major computer manufacturers.

What helped Intel gain the prominence that it has today was IBM's selection of the 8088 for the original IBM PC, introduced in 1981. The PC made many compromises in the name of cost-effectiveness. Major functions including video and disk storage were stripped out and incorporated on separate plug-in boards. That, in turn, helped to create a huge market for peripherals. No one, including IBM, accurately forecast the impact the PC would have. ✓

Micro Glossary

Cache — A small amount of high-speed memory that stores information for immediate use by the CPU. Primary cache may be built into the CPU itself, and additional (secondary) cache may be available as fast RAM.

CISC — Complex instruction set computing: Typified by complex instruction sets and address modes, and relatively expensive silicon. Compare RISC.

DLC — Suffix used by Cyrix for its 486SX-compatible CPUs. Cyrix's 486DLC is pin-compatible with the Intel 386DX and has only 1 kilobyte of on-chip cache, versus 8 kilobytes on an Intel 486.

DX — Intel suffix indicating several different features. The 80386DX supports a full 32-bit data bus, and the 80486DX contains an 8-kilobyte cache and a math coprocessor. Advanced Micro Devices also uses the DX suffix. Compare SX, DX2.

DX2 — Intel suffix indicating that the CPU runs internally at twice the bus speed. For example, a DX2/50 runs at 50 MHz internally, but the memory interface runs at 25 MHz. Compare SX, DX.

DXLV — Advanced Micro Devices suffix for a low-voltage 386DX.

FPU — Floating point unit, also called a math coprocessor. A specialized IC designed to perform floating-point math more efficiently than an ordinary CPU.

MIPS — Millions of instructions per second, a relative measure of CPU performance. A higher value indicates a faster CPU.

OverDrive — Intel's trade name for its fifth-generation microprocessor.

Pipelining — Design technique used to improve performance by allowing the processor to begin work on a subsequent instruction before completing the current instruction.

Power management — Circuitry that regulates the power consumption of a computer by effectively "turning off" power-hungry devices that are not being used.

RISC — Reduced instruction set computing: Typified by simple instruction sets and address modes, and relatively inexpensive silicon. Compare CISC.

SL — Intel suffix representing a low-power CPU (usually for mobile computers). The SL line has been canceled, and its features folded into more recent 486 and Pentium CPUs.

SX — Intel suffix with various meanings. Internally, the 80386SX supports a full 32-bit data bus, but externally, only 16 bits. The 80486DX allows the full bus width, but disables the internal math coprocessor. Compare DX, DX2.

SXL — Advanced Micro Devices suffix for low-power SX CPU. ✓

Thought For The Month

A synonym is a word you use when you can't spell the first word you thought you would use.

In Memorium

On May 6, 1995, Gary Campbell passed away. Gary was a member of this club throughout its existence and has served as an officer for most of those years. He became the Fort Worth Chapter's first Librarian at its first meeting in February of 1984. Since then he has served as Librarian of the Fort Worth Chapter, the Amiga By-The-Loop Chapter, and of the MCCC as a whole, often holding more than one position at a time.

Those of us lucky enough to have known him, knew a selfless friend, always ready to help in any way he could.

He will be missed.

A PowerPC Amiga?

Dave Haynie gives his opinion
info from the internet

There is a significant "row" going on in comp.sys.amiga about ESCOM and what they should or might produce. One thing people are concerned about is a PowerPC version of the Amiga. "Just another Mac platform." It seems there are good reasons such a platform will be able to run the Mac OS as well as probably OS/2. Dave lays them out in this message.

On Friday, 28 April 1995, Frank MacCrory wrote:
I don't see how the PowerPC chip automatically qualifies a PC as a mac.

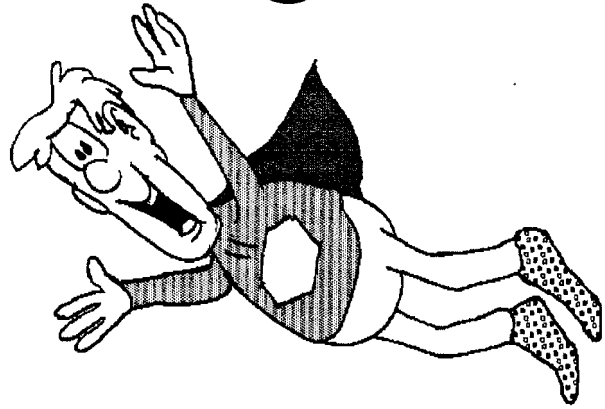
Well, it doesn't. But you don't simply use the PowerPC chip. One essential in going to a new RISC platform is to support whatever multivendor system standard that goes along with that chip. On the PC, this is the defacto PC-AT+, kind of an ad hoc standard. On the PowerPC, this was PReP, but Apple cleverly maneuvered this into their new standard which includes the non-PReP PowerMac features. So any PowerPC system designed to this standard can run the PowerMac OS.

The whole idea is that software companies want to be able to deliver shinkwrapped OS software, and that means the OS must know how to access the basic capabilities of any motherboard it runs on. This is achieved through a combination of hardware and low level software (hardware abstraction) that adheres to the standard, whatever that standard is. To build a PowerPC system now and ignore that standard would be like building an 80x86 computer back in the early 80s without assuring it was IBM compatible.

Perhaps the PC and Mac clones ESCOM has talked about selling eventually will be OS-flexible Amigas.

You certainly could build a PowerPC Amiga that conforms to the PowerPC system standards, and a version of AmigaOS that runs on any standard machine. You're going to loose some source-level compatibility going from 680x0 to PowerPC, though tricks like they play on the PowerMacs can minimize this. A switch to a more different architecture will add to the changes necessary to retarget software, but that's worth doing. Emulated software, being emulated of course, doesn't have any problems running on the new architecture. And compared to most OSs, the Amiga OS is pretty architecture dependent. Platform changes are trivial when compared to the big picture of a port of the OS.

Using the Amiga OS as a manager for other operating systems, why not build in a TAOS-like facility that would



translate system calls on the fly?

Usually, when you're talking about this kind of thing, what you're actually doing is host a foreign APL. What that amounts to is a special task environment; a kind of virtual machine that runs under the host task, providing the software environment expected under that alternate OS. That's essentially what Emplant is doing with the MacOS, by using the Mac OS itself to provide the environment. You can't necessarily do that with every other OS itself, but you could mimic an API with AmigaOS like that, though it could turn out to be a great deal of work. Also, you would really need a protected AmigaOS with the ability (though not necessarily requirement) to launch tasks with their own private address spaces.

Would it be possible to make an Amiga with a hardware design so modular that you could replace the main processor, coprocessors, even the system bus simply and easily?

Everything but the system bus. All your options have to meet somewhere, after all. The "next generation" architecture, "Acutiator," that I designed near the end of Commodore did this. You would have a motherboard that consisted primarily of a module bus controller (PCI) and some basic I/O ports. CPU, graphics, etc. would go in as cards.

Could you design a flexible bus controller (maybe even an 020/030) and simple adaptors that would allow you to install any expansion card (PCI, ISA, NuBus, etc.) in an Amiga?

Not quite. Though one in idea I had for Acutiator, you did have a modular expansion bus. The main system board would be under 11" x 8", and this could give you a compact desktop system. Put it in a tower case, and connect a backplane board (next to the main one), and you would have a Zorro III, or potentially any other bus, as long as you had a PCI bridge for that bus. ✓

Amiga Library News

public domain and shareware picks
from Bill Raecke

FastView by John Hendrikx
Looking for the perfect picture viewer? This may well be it! *FastView* is the one I have installed in my system. It handles just about all the important picture formats — standard IFF (including HAM-8), GIF and JPEG. And it also handles some formats that haven't been handled by PD viewers previously — like BMPs and PCXs. As icing on the cake, each of those formats is automatically adjusted for YOUR computer. If you have an ECS machine, it displays them as HAM (even the HAM-8 is displayed in standard HAM format). If you have an AGA Amiga, a HAM-8 or 256-color display is used. All this in only a 22K program. Get it! Then send in your \$15 registration fee. Version 1.41 is on MCCC-A_869.

Tracker Music

There are a couple of tunes worth checking out this month. Be sure to listen to *Beneath Dignity*, *Digging*, and *Interceptia* on MCCC-A_870; *Funk It Up* on 871;

Virus Checker by John Veldthuis

Another update. I don't have anything new to say about this one. Just that you need to stay current on your virus protection software and this is the one I recommend. The latest is version 6.53 and it's on MCCC-A_871.

DeliTracker II by Delirium SoftDesign

I just wrote about this one last month, didn't I? Yep, I did! This is the latest update. Version 2.14 is on MCCC-A_874 (in archived format — 'cause that's the only way it will fit!). It's still my second choice (*MultiTracker* being the first choice), but it's an excellent program and worth taking a look at.

Diamond Caves by Peter Elzner

Looking for the perfect *Boulder Dash* clone? This may well be it. Collect all the diamonds without getting squashed by falling rocks or caught by any of various monsters or blown up or... well you get the idea. Oh, by the way — you need to do this before your time runs out. *Diamond Caves* is a lot of fun and it's VERY addictive. Version 1.5 is the latest and it's on MCCC-A_875.

Scorched Tanks by Michael Welch

You've probably played *Scorched Tanks* by now. I know I've recommended it before. *Scorched Tanks* is one of the two best *Artillery* games for the Amiga, the other being *Charr* that I wrote about last month. You choose your weapon, try to zero in on your opponents' position, and blast away. You take turns until one or the other of you is destroyed. *Scorched Tanks* can be played against

human or computer opponents — up to four players at once. I play against at least two computer opponents for a greater challenge. The latest is version 1.85 on MCCC-A_877. It has better music, more weapons, etc.

Escher Pictures

Fans of M.C. Escher, this is your month. There are several digitized pics of Escher's work on this month's disks. We've had a few samples in the past, but these are a higher quality than we've seen before. They are in JPEG format. Be sure to check 'em out. They're on MCCC-A_880 and 881.

Magic Workbench Icons

Looking for more icons? I seem to spend a great deal of time trying to make my Workbench look good. Trouble is, I have no artistic ability to speak of, so I depend on these collections of icons to provide me with what I need. This was a good month. On MCCC-A_882 is a collection of drawers with various pictures on them to represent what lies within. On MCCC-A_883 are a couple of more collections of various icons. And on MCCC-A_884 you'll find still more!

MagicWB 1.3 by Cleo Saulnier

By the way, if you are still using Workbench 1.3, you have been left out of all the Magic Workbench fun. Icons that are designed to run on an 8-color screen don't look like much on Workbench 1.3's 4-color palette. Now there's a solution! Of course the best solution is to buy Workbench 2.1 or 3.1 — you should have done that already. But as a stopgap measure, this little program adds 4 more colors to your Workbench. Also included are some simple icon manipulation tools to help you get your Workbench looking good in no time at all. Check out MCCC-A_884 for this one.

TTX TopScreen by Daniel Barrett

For those who use *TurboText 2.0* (as I do) as their text editor, *TTX TopScreen* is a handy addition. *TurboText 2.0*, by default, runs on its own public screen or on any specific screen that you specify in your configuration. And, of course, you can override that setting from the shell by specifying a public screen as in "TTX Screen DOpus.1." But what if you want it to pop up on whatever screen happens to be in the front at the time? *TopScreen* is the answer! By passing the command "TTX Screen TopScreen" to *TurboText*, it will do just that. Just put the *TopScreen* command somewhere in your path. Of course, the idea is to tie this command to a hot key using *ToolManager* or some similar program so you never have to look at a shell. *TTX TopScreen* is on MCCC-A_883. ✓

CHAPTER NEWS

Amiga By-The-Loop

May Meeting Johnny Kitchens

If anything can be said about the space of time between the April meeting and the May meeting, it had to be news! The incident in Oklahoma, two hail storms, Escom winning the bid for Commodore, and finally the passing away of a member. That's a lot to pack into a small period of time.

This meeting got started a little late, at 7:45, when David Owens started things going. About 20 people came to our meeting. We started with Ned Kelly, our faithful librarian, telling us about a new Fred Fish disk being available. He asked if anyone would be interested in the disk. He also pointed out that there were 20 plus new disk available in the library. About this time Harold Williams showed up, to tell us of a new SuperDisk, with all sorts of great things to use and play with. From there we went to the sad part of our meeting. Long-time member Gary Campbell had passed away the previous Saturday, May 6, 1995. It seemed that I had known Gary since I had attended my first meeting. I had spent much time on the phone with him trying to talk him through a problem, or just talking about computer stuff. It seemed kind of ironic that I would become part of the same chapter as he was in, but not get to see him there. This was the first year since joining the club that I hadn't seen him. He'll surely be missed, and the Adult disks will never be the same again!

With that, the meeting went back to computer related thoughts. Does everyone know that the club sells 10 packs of disk for \$6.00? We covered the big computer news of the month. As everyone should know, Escom now owns what was left of Commodore. This carried the meeting through a considerable amount of talk. We next discussed the *PageStream* update news. Appears they intend to offer 3.1 sometime this summer, hopefully. *Directory OPUS 5* was next. Someone has actually seen it. It's totally redone, and bears no resemblance to its previous version. Users of the BBS may have noticed some changes. With only a few bugs left to work out, the BBS is really looking good! *Deluxe Paint V* is out, talk of getting a demo for a future meeting was tossed around. We'll see, hopefully. A question on *ProPage* came up next. I think we answered that one. A question on the availability of 3.1, and its reliability then came up. Not only is it available, but I believe it's very reliable, even more so than 2.0.

Finally, we moved our presentation. David Owens brought

his 3000 to the meeting, to show us *Final Data*. Wait — haven't I said this before this year? Yes, but Softwood has updated *Final Data*, so it's time to see it again. Softwood gets my vote for best supporter of the Amiga, and its users. Softwood just finished purchasing the assets of New Horizons, and they are promising updates to *Quarterback*, the hard drive backup utility. *Final Data* offers Amiga users an easy to use database setup, with an interface that resembles *Final Writer* in some ways. Previous database offerings have been either much more complicated, or much simpler than *Final Data*. This gives *Final Data* a slot to fill and a chance for success. I hope Softwood gets rich selling it, because I can hardly wait for their next offering. Rumors of a new *Final Writer* have me excited!

Amiga North Dallas

April Meeting Michael Turner

We had about 25 people show up for our April meeting. VP Steve Nichols called the meeting to order.

Of course, first on the agenda was News and Rumors. There appeared to be quite a lot of both. Eddie and Steve both gave us the latest info on the Commodore legal proceedings.

As to present good news *DeluxePaint* version V is now shipping. Although I haven't seen it yet, I hear it has quite a few new enhancements including handling 24-bit color and full ARexx compatability. The upgrade is available for about \$80 from Electronic Arts.

Amiga North Dallas

The Amiga North Dallas Chapter has changed meeting places. The date and time will remain the same, but because of an abundance of church activities, we no longer have access to the meeting room we used to have. The permanent location is still to be decided, but for now, we're going back to our roots at
The Richardson Civic Center
at the southwest corner of Arapaho at U.S. 75.

We'll be in the West Conference Room.
The meetings scheduled thus far are for
June 20, July 18 and August 15.

We'll be looking for you. Tell your friends!

CHAPTER NEWS

Also Steve mentioned that *Image FX Version II* is now out. Sad to report, however, is the fact that *AmigaWorld* is no more. Apparently, next month's issue is the last. If you haven't received a notice from them concerning your subscription give them a call.

BBS sysop Tom Brooks mentioned that his board A.I. recently got a memory upgrade. He also mentioned he has been cruising the Internet and has picked up the latest animations out there, including those by the Eric Schwartz. (We enjoyed quite a few at our last meeting!) So if you're into animations give his board a call.

This being the end of the news and there not appearing to be any startling rumors, we moved on to any technical questions. This turned into a mighty discussion as one member had a little problem with his harddrive getting to boot up. Apparently, he had two harddrives hooked together that would work fine when warm booting but could not get the computer to boot from the right harddrive when powering up. This prompted a discussion on compatible harddrives, rewriting startup-sequences, and even booting from a floppy disk then directing the system to make the right harddrive the main system disk. Anyway, if we didn't confuse him he probably got some good advice!

Last, but certainly not least, Ned mentioned that a date has been set for this years METCOM. That date is Saturday, September 30th. It will be held the same place as last year's — the Arlington Convention Center. Ned did mention that the

Center may charge for parking this year so bring a couple of extra bucks for that. Also, any old Amiga knick knacks that you might wish to sell please get ready. Ned mentioned that whatever vendors he can find, a member flea market and our own illustrious PD library will all be there. If you missed last year's, you missed quite an event. Don't miss this year's!

With the question and answer portion ended, we proceeded on to the main event. This was Steve's presentation of *OctaMed*. As I probably mentioned before, *OctaMed* is a music and sound program that is just hard to beat. *OctaMed* can play several different types of sound and music files and also has a sample editor. Steve demonstrated version IV as he said he was using it before he had upgraded his A500 from Workbench 1.3.

This prompted a small side discussion as to how he upgraded his A500 and his advice for pulling chips from the board. Steve mentioned that the instructions that came with his Workbench upgrade were excellent and the only problem he had was that the chip puller that

came with the kit was virtually useless. (He mentioned something about using a small set of pliers!)

Our noble presenter worked his way through the music editor (and some good-natured ribbing from his friends in the front row known affectionately as "the interactive video") and demonstrated some of the songs he had written as well as some of the songs that he had picked up from the public domain. He even took questions and requests from the audience, demonstrating a remarkable working knowledge of the program.

While Steve was showing how the sampling editor works, Gus asked Steve if he could take a sound wave, reverse it, and play the original and the reversed version back at the same time thru separate channels so that they would cancel out and thus we would hear nothing!! (Even if there wasn't a presenter at our meetings, the audience participation would be a show in itself...)

At that question, all agreed it was time to end the meeting.

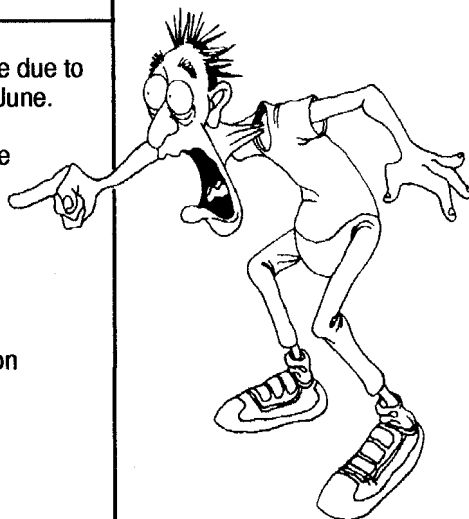
Membership Notice

As of this printing, these memberships expired in May.

Allan Casanova
Adrian Dixon
William Dockendorf
M.B. Hagedorn
Ray Howard
Charles Kelly
Dwight Kirvin
David Lund
John McHugh
Chris Scheers
Randy & Deannelle Sheppard
Alan Somers
Ed Stasky

These memberships are due to expire at the end of June.

Daniel Bonaparte
Bob Chancy
Kenneth Craig
Michael Ellis
Marvin Hartog
George Khoury
Joe Ostrokol
George Robertson
Jerry Smith
Victor Spears
Arthur Wright



The Fine Print

The Metroplex Commodore Computer Club

Statement of Purpose: The Metroplex Commodore Computer Club is a not-for-profit organization devoted to the collection and dissemination of computer knowledge, to the encouragement of computer education, and to the use of Commodore computers in the home, at school, and in business.

Legal Stuff: The MCCC is not connected with Commodore Business Machines, Inc. Commodore and Commodore product names (PET, CBM, VIC, C64, C128, and Amiga) are registered trademarks of Commodore, Inc.

Meetings and Membership: Our meetings are open to all. Family membership dues are \$24 per year or \$15 for six months, and entitle the member to a monthly mailed copy of the MCCC News, free access to the club's extensive public domain and shareware software library, and discounts at many area merchants. An additional \$12 annual fee provides access to the MCCC multi-user Bulletin Board System.

The MCCC News

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Advertising: The MCCC News accepts two kinds of advertising. Member ads are those which are submitted by a member and which are not of a commercial nature. There is no charge for member ads. Commercial ads are those which advertise multiple like items for sale. Rates for camera-ready commercial ads are as follows for a single month or (prepaid consecutive three months): Full Page — \$36 (\$96); Half Page — \$18 (\$48); Quarter Page — \$12 (\$32); Business Card — \$6 (\$16). Materials to be inserted will cost \$.08 per copy (duplication not included) and must be inserted into all newsletters for the month.

Articles: Members are encouraged to submit articles. Articles may be submitted as ASCII text or in Amiga *excellence!*, *ProWrite*, *WordPerfect* or *Final Writer* format. They may be uploaded to the MCCC BBS, to StarText, or submitted on disk. If these methods are not possible, I will, as a last resort, accept printed articles. If graphics need to be included they may be submitted as IFF files, DR2D, *PageStream* or *Art Expressions* structured drawings, *Professional Draw* clips or, again as a last resort, printed output.

Deadline: The deadline for submissions to the MCCC News is 7am of the fourth Saturday of each month. Payment must accompany all ad copy. Make checks payable to MCCC and mail c/o Bill Raecke, 2614 Charolais Way, Arlington, Texas 76017.

Extra Copies: Extra Copies of the MCCC News are available at \$1 per copy. Orders should be forwarded with the required fee by the regular newsletter deadline.

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Librarian	Jo Lynn Linville	817-783-2784

Normal Meeting Schedule

1st Tuesday	MCCC Board of Directors
2nd Tuesday	Amiga By-The-Loop Chapter
2nd Saturday	Metro C-64/128 Chapter
3rd Tuesday	Amiga North Dallas Chapter

CALENDAR OF EVENTS

June 6 MCCC Board of Directors
7:30 pm — N.Richland Hills Community Center
Loop 820 at Rufe Snow, N.Richland Hills

June 10 Metro C-64/128 Chapter
1:30 pm — UNT Health Sciences Building
Lancaster & Camp Bowie, Fort Worth

June 13 Amiga By-The-Loop Chapter
7:30 pm — N.Richland Hills Community Center
Loop 820 at Rufe Snow, N.Richland Hills

June 20 Amiga North Dallas Chapter
7:30 pm — Richardson Civic Center
Arapaho at U.S. 75 (SW Corner), Richardson

July Newsletter Deadline — 7am, June 24



These Dealers offer discounts to MCCC members
Be sure to show your membership card

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